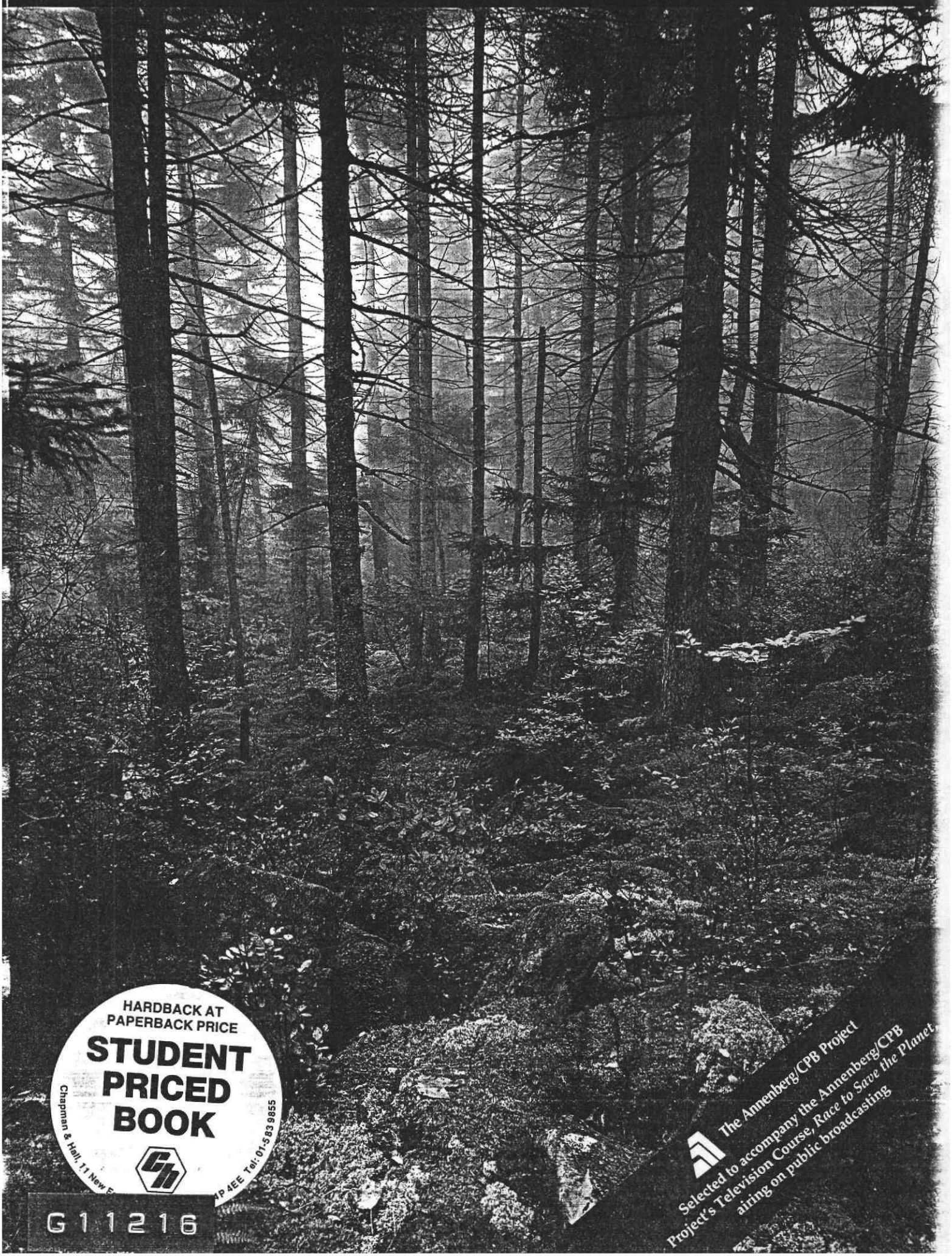
Le milieu environnant et l'homme. Ouvrage encyclopédique très dense concernant tous les risques pour l'homme et la nature provenant de la pollution. Glossaire et bibliographie en fin d'ouvrage.
G 11216.

LIVING IN THE ENVIRONMENT/SIXTH EDITION/G. TYLER MILLER, JR.





The Annenberg/CPB Project
Selected to accompany the Annenberg/CPB Project's Television Course, *Race to Save the Planet*, airing on public broadcasting

# Preface: To the Instructor

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**Goals** This book is designed to be used in introductory courses on environmental science. My goals for the book are to

- cover the diverse materials of an introductory course on environmental science in an accurate, balanced, and interesting way without the use of mathematics or complex chemical and biological information
- help your students discover that dealing with environmental and resource issues is fun, interesting, and important to their lives
- allow you to use the material in a flexible manner to meet your needs depending on course length and what you believe are the important topics
- introduce students to key concepts and principles that govern how nature works and apply them to possible solutions to environmental and resource problems
- show how environmental and resource problems are interrelated and must be understood and dealt with on local, regional, national, and global bases
- give a realistic but hopeful view of how much has been done and what remains to be done in sustaining the earth
- indicate what students can do in their personal lives and life-styles to help sustain rather than degrade the earth's life-support systems

**A Well-Tested Book** The material in this textbook has been used and class-tested by well over 1 million students at over two-thirds of the country's colleges and universities. It has been the most widely used environmental science textbook in the United States since 1975, when the first edition was published.

**Concept Centered** The text was the first to use basic principles and concepts to help students understand environmental and resource problems and possible solutions to these problems. This approach gives students a way to tie together and evaluate the massive amount of information in the field. I have introduced only the concepts and principles necessary to understanding material in this book, and have tried to present them simply but accurately.

**Three Different Textbooks Available** This book is one of a series of three textbooks designed for different introductory courses on environmental science and resource conservation.

- This book, *Living in the Environment* (6th ed., Wadsworth 1990, 620 pages), gives broad and fairly detailed discussions of environmental and resource issues.
- *Environmental Science: An Introduction* (2d ed., Wadsworth, 1988, 406 pages) is a brief version of *Living in the Environment* that omits detailed discussions of many topics.
- *Resource Conservation and Management* (Wadsworth, 1990, 546 pages) has a different organizational pattern and content than the other two textbooks. It includes more detailed discussions of living resources. It has separate chapters on food, fishery, forest (two chapters), and wildlife (two chapters) resources and their management and less detailed discussions of ecological concepts, population, and pollution than *Living in the Environment*.

**Readability** Students often complain that textbooks are difficult and boring. I have tried to overcome this problem by writing this book in a clear, interesting, and informal style and relating the information in the book to the real world and to the student's own life. My goal has been to keep sentences and paragraphs short and avoid the use of a long word when a short one can express an idea just as well.

**Flexibility** I have designed this book to be flexible enough to be used in many different ways by dividing it into six major parts:

- Humans and Nature: An Overview (two chapters)
- Basic Concepts (four chapters)
- The Human Population (three chapters)
- Resources (eight chapters)

ing (p. 405), determining toxicity levels (p. 450), risk assessment and risk management (p. 458), international toxic waste trade (p. 478), asbestos (p. 491), and the Valdez oil spill (p. 534).

- Special emphasis has been placed on improving readability by reducing sentence and paragraph length, omitting unnecessary details, and writing in a more personal style.
- Ten new guest essays have been added to eight used in earlier editions.
- 146 new illustrations and photographs have been added.
- A two-page summary of key ideas has been placed inside the front cover.

**Help Me Improve This Book** I need your help in improving this book in future editions. Writing and publishing a textbook is an extremely complex process. Thus, any textbook is almost certain to have some typographical and other errors. To minimize errors, I have had all or parts of the manuscript reviewed by a large number of teachers and experts.

If you find any errors, please write them down and send them to me. Most errors can be corrected in subsequent printings of this edition, rather than waiting for a new edition.

I would also like to know how you think this book can be improved. We all have the same goal: finding the best way to teach students about this field. Helping me do this helps you and your students. I also hope you will encourage your students to evaluate the book and send me their suggestions for improvement.

Send any errors you find and your suggestions for improvement to Jack Carey, Science Editor, Wadsworth Publishing Company, 10 Davis Drive, Belmont, CA 94002. He will send them on to me.

**Supplementary Materials** Dr. David Cotter at Georgia College has written an excellent Instructor's Manual and Test Items Booklet for use with this text. It contains sample multiple-choice test questions with answers, suggested projects, field trips, experiments, and a list of topics suitable for term papers and reports for each chapter. Master sheets for making overhead transparencies of many key diagrams are also available from the publisher.

**Annenberg/CPB Television Course** This textbook is being offered as part of the Annenberg/CPB television course *Race to Save the Planet*, to be broadcast on PBS beginning in the fall of 1990.

*Race to Save the Planet* is a ten-part public television series and a college-level television course examining the major environmental questions facing the world today, ranging from population growth to soil erosion, from the destruction of forests to climate changes induced by human activity. The series will take into account the wide spectrum of opinion about what constitutes an environmental problem, as well as the controversies about appropriate remedial measures. It will analyze problems and emphasize the successful search for solutions. The course will develop a number of key themes that cut across a broad range of environmental issues including sustainability, the interconnection of the economy and the ecosystem, short-term versus long-term gains, and the tradeoffs involved in balancing problems and solutions.

In addition to my books (*Environmental Science* and *Living in the Environment*) and the video programs, the course will include a study guide and faculty guide available from Wadsworth Publishing Company. The television course is being developed as part of the Annenberg/CPB collection.

For further information about available television course licenses and off-air taping licenses contact: PBS Adult Learning Service, 1320 Braddock Place, Alexandria, VA 22314-1698, 1-800-ALS-ALS-8.

For supplementary audiovisual use, videocassettes and off-air taping licenses are available. For information, contact: The Annenberg/CPB project at PO Box 1922, Santa Barbara, CA 93166-1922, 1-800-LEARNER.

**Acknowledgments** I wish to thank the many students and teachers who responded so favorably to the first five editions of *Living in the Environment* and the two editions of *Environmental Science* and offered many helpful suggestions for improvement.

I am also deeply indebted to the 217 reviewers of this and previous editions who pointed out errors and suggested many important improvements and to those who wrote guest essays. Any errors and deficiencies left are mine, not theirs.

Others have also made important contributions. They include production editors Michael Oates and Hal Humphrey, copy editors Noel Deeley and Lura S. Harrison, art editor Donna Kalal, photo researcher Stephen Forsling, designer Andrew Ogus, dummier Edie Williams, print buyers Karen Hunt and Barbara Britton, editorial assistant Olivia Wirthman, and artists Darwin and Vally Hennings, John and Judith Waller, Linda Harris-Sweeney, Raychel Ciemma, Victor Royer, Joan Carol, Salinda Tyson, Jeanne M. Schreiber, Susan Breitbard, Shirley Bortoli, and Florence Fujimoto.

Above all I wish to thank Jack Carey, science editor at Wadsworth, for his encouragement, help, friendship, and superb reviewing system. It helps immensely to work with the best and most experienced editor in college textbook publishing.

*G. Tyler Miller, Jr.*

- Pollution (four chapters)
- Environment and Society (three chapters)

After you have covered all or most of Parts One and Two, you can cover the rest of the book in almost any order. For example, after covering the concepts in Part Two some of you may wish to then cover pollution in Part Four or you may wish to cover environmental economics, politics, and ethics in Part Six. These and other rearrangements of the course content can easily be done. Also most chapters within parts and many sections within these chapters can be moved around or omitted to accommodate courses with different lengths and emphases.

**Other Major Features**

- *Balanced discussions of opposing views* on major environmental and resource issues, especially in the 26 boxed *Pro/Con* discussions found throughout the book.
- *Emphasis on what individuals can do.* Most chapters end with a section on *What Can You Do?* Also see the suggestions for conserving water and energy inside the back cover.
- Content based on an *extensive review of the professional literature* (from more than 10,000 research sources); key readings for each chapter are listed on pp. A10-A35).
- *Extensive manuscript review* by 217 experts and teachers (see list on p. x) to help make the material accurate and up-to-date. Several experts reviewed each chapter. Teachers of environmental science courses or related types of courses reviewed most or all of the manuscript.
- 18 *Guest Essays* to provide more information and expose the reader to various points of view.
- 51 *Case Studies* to give in-depth information about key issues and to apply concepts.
- 52 *Spotlights* to highlight and give further insights into environmental and resource problems
- 419 *diagrams and carefully selected photographs* to illustrate complex ideas in a simple manner and to show how topics in the book relate to the real world.
- *Summary of key ideas* inside the front cover.

**Learning Aids** To help students learn more effectively, I have included a number of aids.

- *General Questions and Issues:* Each chapter begins with several simple questions (see p. 158). They give the student an overview of the chapter and can also be used as review questions after the chapter is completed.
- *Chapter Summaries*
- *Key Terms:* When any new term is defined it is shown in **boldfaced** type.
- *Discussion Topics:* Each chapter has several discussion questions designed to encourage students to think about and apply what they have learned.
- *Glossary:* All key terms are defined in a glossary near the end of the book.

**Major Changes in This Edition** Despite the success of this textbook, the publisher and I feel obligated to improve each edition to meet changing needs indicated by the extensive reviews and surveys of users. *This new edition is a major revision.* The major changes in this edition include:

- Material throughout the book has been updated and rewritten to make this an even better textbook. Since the information and many of the problems in this diverse field change on an almost yearly basis, frequent updating (ideally every two years) is more important than in most introductory courses.
- The number of chapters has been reduced from 26 to 24 by editing and rearranging of topics. The number of chapters on energy resources in Part Four has been reduced from three to two. Hazardous waste and risk analysis have been placed in Chapter 18 on Environment, Health, and Risk.
- The chapters on Environment, Health, and Risk (Chapter 18), Environmental Economics (Chapter 22), and Environmental Politics (Chapter 23), have been completely rewritten with the help of a number of experts in these fields. There is also expanded treatment of tropical deforestation, ozone depletion, and global warming.
- 51 Case Studies and 216 Pro/Con discussions of controversial issues have been added.
- Many new topics have been added including: jobs and environment (pp. 16 and 524), agenda for the future (p. 46), Gaia hypothesis (p. 143), importance of wetlands (pp. 122 and 128), nature of science and technology (p. 72), genetic engineering (p. 148), ecosystem restoration and rehabilitation (p. 151), the birth dearth controversy (p. 174), AIDS (p. 481), water rights (p. 254), home gardening and lawn care (p. 232), polyculture (p. 266), environmental impact of agriculture (p. 271), sustainable agriculture (p. 281), fires in Yellowstone National Park (p. 302), animal rights (p. 319), Arctic National Wildlife Refuge (p. 333), rock cycle and plate tectonics (p. 334), recycling of plastics (p. 367), safety at nuclear weapons facilities (p. 399), nuclear power as a solution to global warm-

Pessimists who think we are doomed and optimists who blindly think everything will be all right regardless of what we do are dangerous people. These extreme positions are mind games that people use to avoid thinking about problems and becoming involved in bringing about change. This book is written for doers who care about the earth, not bench-sitters and toe dippers who care only about themselves.

In this book I offer a realistic but hopeful view of the future. Much has been done since 1965, when many people first became aware of the resource and environmental problems we face today. But much more needs to be done to protect the earth, which keeps you and all other forms of life alive. This book suggests ways that you can help sustain—not degrade—the earth.

As you will learn, most environmental and resource problems and their possible solutions are interrelated. Treating them in isolation is a recipe for disaster. They must also be considered on a local, national, and global scale—as this book does.

**How the Book Is Organized** This book is divided into six major parts:

- Humans and Nature: An Overview (two chapters)
- Basic Concepts (four chapters)
- The Human Population (three chapters)
- Resources (eight chapters)
- Pollution (four chapters)
- Environment and Society (three chapters)

Look at the Brief Contents on p. xiii to see the topics covered in each part. Before studying each chapter, I also suggest that you look over its detailed contents given on pp. xiv–xviii. This gives you a road map of where you will be going.

**This Book Is Flexible** I have designed the book so that it can be used in courses with different lengths and emphases. This gives your instructor great flexibility in designing the course you are taking.

The material in Parts One and Two gives you the background, basic definitions, and concepts needed to understand the rest of the book. Once you have studied most or all of Parts One and Two, you can cover the other four parts in any order your instructor assigns. Chapters in these parts and many sections within chapters can be rearranged or omitted. So don't be concerned if your instructor skips around and omits material.

**General Questions and Issues and Chapter Summaries** I believe in the old writing and teaching adage: Tell people where you are going, go there, and then remind them of where they have been. Each chapter begins with a few general questions to give you an idea of what you will be learning in each chapter. After you finish a chapter you can go back and try to answer these questions to review what you have learned.

You will also find a brief summary at the end of each chapter. Reading the summary should not replace reading the entire chapter. The summary is a review that omits much of the information needed for adequate understanding of the material.

Frankly, I have some misgivings about chapter summaries. They tempt people to read the summary and not read the chapter. Also my gut feeling is that you should be making your own summaries. But many instructors and students want them so I have provided them.

**Vocabulary** Each chapter will introduce new terms, whose meanings you need to know and understand. When a term is introduced and defined, it is printed in **boldfaced** type. There is also a glossary of all key terms at the end of the book.

**Visual Aids** Learning requires verbal and visual inputs. I have developed a number of diagrams to illustrate concepts and complex ideas in a simple manner. I have also used a number of carefully selected photos to give you a better picture of how topics discussed in this book relate to the real world.

**Discussion Topics** Each chapter ends with a set of discussion questions designed to encourage you to think and to apply what you have learned to your personal lifestyle. They also ask you to take sides on controversial issues and to back up your conclusions and beliefs.

I have not provided questions that test your recall of facts. This important but mechanical task is left to you and your instructor. As a college student you should know how to learn definitions and facts on your own. It is done the old-fashioned way—reading, marking key passages, making notes and summaries, and writing and studying flash cards.

**Further Readings** If you become especially interested in some of the topics in this book, you can get more information by reading other books and articles. A list of suggested readings for the material in each chapter is given in the back of this book beginning on p. A10. Also, Appendix 1 is a list of publications you can use to keep up to date on the material in this book.

**Interact with the Book** When I read something, I interact with it. I mark sentences and paragraphs with a highlighter or pen. I put an asterisk in the margin next to something I think is important and double

# Preface: To the Student

**Why Study About Resource and Environmental Issues?** This is not just another college course to be passed for credit. It is an introduction to how nature works, how the environment has been and is being used and abused, and what you can do to protect and improve it for yourself and other people, future generations, and other living things. I am convinced that nothing else deserves more of your energy, time, concern, and personal involvement.

Studying environmental and resource problems is different than studying most courses like chemistry, biology, economics, or psychology. Why? Because it is an *interdisciplinary* study. It involves combining ideas and information from physical sciences such as biology, chemistry, and geology and social sciences such as economics, politics, and ethics to get a general idea of how the world works and what our role in the world should be.

**What Is the Purpose of Learning?** *The purpose of education is not to learn as much as you can. It is to learn as little as you can.* The goal of education is to learn how to sift through mountains of information and ideas and find the small amount that is really useful and worth knowing.

Inside the front cover of this book you will find a list of key principles that summarizes what I have learned so far about how the world works and what my role in it should be. These ideas are not original. They are the result of over 40 years of reading books and articles, tens of thousands of conversations with others, letters from students like you, and direct observations of nature.

I use these principles to evaluate other ideas and to make decisions about what to buy or not buy and how to live my life with increased joy. I am also constantly striving to improve this list by modifying or removing some ideas and adding new ones. I make no claims about whether these ideas are true. They are merely what I have found to be useful.

Trying to discover the knowledge that is really worth knowing is an exciting and never-ending process. It's great fun. As you draw up your own list, please send me any ideas you have. We are all in this together and we need all the help we can get.

**How I Became Involved** I feel you are entitled to know how I became involved in environmental and resource concerns and to what degree I try to put what I write about into practice in my own life and lifestyle. In 1966, when what we now know as the environmental movement began in the United States, I heard a scientist give a lecture on the problems of overpopulation and environmental abuse. Afterwards I went to him and said, "If even a fraction of what you have said is true, I will feel ethically obligated to give up my present scientific research on the corrosion of metals and devote the rest of my life to environmental issues. Frankly, I don't want to believe a word you have said, and I'm going into the literature to try to prove what you have said is either untrue or grossly distorted."

After six months of study I was convinced of the seriousness of these problems. Since then I have been studying, teaching, and writing about them. I have also attempted to live my life in an ecologically sound way—with varying degrees of success—by treading as lightly as possible on the earth. Working toward this goal has involved making more compromises and trade-offs than I have liked. But I continue the effort (see p. 444 for a summary of my own progress in attempting to work with nature).

**Readability** Students often complain that textbooks are difficult and boring. They are usually right, although some are unwilling to put in the time and hard work that reading and understanding always take.

I have tried to overcome this problem by writing this book in a clear, interesting, and informal style. I keep sentences and paragraphs fairly short. I try not to use long words when short ones can express an idea just as well. My goal is to communicate with you, not confuse you.

I also relate the information in the book to the real world and to your own lifestyle, in the main text and in boxed Spotlight, Case Studies, and Pro/Con discussions of issues sprinkled throughout the book.

**A Realistic but Hopeful Local, National, and Global Outlook** We face many environmental and resource problems. But a problem is an opportunity for change.

asterisks next to something that I think is really important. I write comments in the margins, such as *Beautiful, Confusing, Bull, Wrong,* and so on.

I fold down the top corner of pages with highlighted passages and the top and bottom corners of especially important pages. This way I can flip through a book and quickly review the key passages. I hope you will interact in such ways with this book. You will learn more and have more fun. I hope you will often disagree with what I have written and take the time to think about or write down why.

**Save This Book** After you finish this course, you may be tempted to discard this book or resell it to the bookstore. But learning is a lifelong process and you will have to deal with the vital issues discussed here for the rest of your life. Therefore, I hope you will keep this book in your personal library for future use. Or at least pass it on to someone whom you want to learn about the earth.

**Help Me Improve the Book** I need your help in improving future editions. Writing and publishing a book is an incredibly complex process. That means that this or any other book is likely to have some typographical and factual errors. If you find an error, write it down and send it to me.

I would also appreciate learning from you what you like and dislike about the book. This information helps me make the book better. Some of the things you will read here were suggested by students like you.

Send any errors you find and any suggestions for improvement to Jack Carey, Science Editor, Wadsworth Publishing Company, 10 Davis Drive, Belmont, CA 94002. He will send them on to me.

Your input helps me, students who take this course in the future, and the earth.

**And Now** Relax and enjoy yourself as you learn more about the exciting and challenging issues we all face in sustaining the earth's life-support systems.

*G. Tyler Miller, Jr.*